

**MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE  
SUMY STATE UNIVERSITY  
UKRAINIAN FEDERATION OF INFORMATICS**

# **PROCEEDINGS**

**OF THE IV INTERNATIONAL SCIENTIFIC  
CONFERENCE**

**ADVANCED INFORMATION  
SYSTEMS AND TECHNOLOGIES**

**AIST-2016**



**May 25 –27, 2016  
Sumy, Ukraine**

# Reducing Uncertainty and Risk in Early Stages of Complex Product Development Projects

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**Abstract.** *The concept of risk and uncertainty in project and their relationship is investigated. Early stages of complex product development projects and their specifications are analyzed. It is suggested to reduce the uncertainty and risk of the project in its early development stages by making decisions between alternatives with an awareness of the risks associated with each alternative.*

**Keywords.** *Risk, Uncertainty, Complex Project, Decision Making, Alternative Selection.*

## INTRODUCTION

The development of complex products and systems is a priority for the growth of any country's economy and is achieved by conducting a series of complex and long-term projects and programs. The most dominant properties of complex projects are: presence of many interconnected subsystems and components, high degree of innovation and collaboration during design and implementation; the use of various approaches and large variety and number of experts.

One of the most outstanding characteristic of these projects is high degree of risk and uncertainty as the result of their inherent complexity.

## THE CONCEPT OF RISK AND UNCERTAINTY

Authors performed an extensive research about the notions of risk and uncertainty and their relation in project. It can be stated that there is not a unique understanding and definition of them. In some cases, the risk and uncertainty are referred as synonyms; therefore, there is not any connection between them. However, [1] believes that risk and uncertainty are not identical concepts. The risk exists when the probability of

its occurrence can be determined based on statistics from previous projects or by expert methods while uncertainty assumes the presence of factors under which the results of activities are not deterministic, and the degree of the possible impact of these factors is unknown.

According to [2], uncertainty in projects may be interpreted as two concepts: variability and ambiguity. Variability refers to a situation when a measurable factor can take on a range of possible values. In this case, the event is defined, but the outcome is uncertain because it is variable. However, ambiguity refers to uncertainty of meaning. Here the issue is not the probability of an event producing a particular value; it is the uncertainty about the event itself, with a lack of clarity over some aspect of its existence, content or meaning. Both ambiguity and variability exist throughout the project life cycle, but they are particularly predominant at the early stages of a project [3].

In [4] project risk is described through the interrelated categories: uncertainty, risk and loss. Uncertainty is characterized by incomplete and/or unreliable source of information about the project and probabilistic character of future events and can be described and analyzed by mathematical concepts and tools. Then, project risk occurs as the result of uncertainty of the future events, and the amount of loss (damage) is the result of the risk event.

## RISK OVER THE PROJECT LIFE CYCLE

Analyzing the changes of risk and uncertainty, the costs and the change costs over the project life cycle shows that: Project costs are small in the beginning, reaching a peak at the implementation phase and rapidly fall at last phases (completion)

of project. Risk and uncertainty have the highest value at the beginning of the project and decrease in the course of performing the project. The cost of changes and correcting errors and repeating the tasks, as a rule, significantly increases as we approach to the end of the project.

First phases of development are critically important in complex product's life cycle because this is when the main decisions are made which in turn determine the product performance and development project's cost, time and quality. Some distinguished features of these phases are:

1) High uncertainty due to lack of precise knowledge of the projects and products

2) Large number of iteration cycles for achieving the desired consistency of results

3) The requirement of making principal project decisions (selection between alternatives); the result of decision mainly affect the project goals.

4) The predominant root causes of risks at this stage are the scientific and technical factors (comparing with cost and time root causes)

5) The mechanism for eliminating most of the risk factors is rescheduling and repeating a series of tasks.

Project risk management is one of main project management parts and according to the Project Management Institute's PMBOK, it is one of the ten knowledge areas in which a project manager must be competent. Various methods and standards of risk management have been introduced so far; but they suggest the common steps and only differ in some details. The main steps of project risk management process include planning, identifying, evaluating, responding, controlling and monitoring the risks.

In our research, we propose the concept of reducing the change costs of last project stages by reducing the level of uncertainty in the early stages of development.

One of the efficient ways for performing this concept can be carried out within alternative

(variant) selection activities. It is proposed to make decisions between alternatives with an awareness of the risks associated with each, thereby helping to prevent late design changes and their resulting risks and problems. The alternative selection activities are not assumed to be risk because they are inevitable activities and probability of their occurrence in project is 100% while the definition of risk states that risk event must have the probability of less than unity. However, as the result of alternative selection activities and depending on the selected alternative, risks of project implementation may vary considerably. Once the alternative is selected and its specifications are established, the prevalent risk management method can be used to manage risks against these determined specifications.

## CONCLUSIONS

It can be concluded that at the early stages of the project the correct analysis and decision making under conditions of high uncertainty significantly affects the cost of the project completion. The proposed concept helps the project manager in reducing the sources of uncertainty by increasing his knowledge about the risks of different project solutions. This uncertainty if not managed effectively, can be key driver of cost overruns, schedule delays, and in extreme cases, the project cancellation.

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